RWTH Aachen Physik
AG Prof. Dr. M. Morgenstern

Inst. II B

Master thesis

Depositing patterned Pb islands on a topological insulator with a UHV mask aligner

Ultraclean nanostructuring requires to avoid any kind of dirt on the sample as typically appearing after standard lithography using polymer resists. Such dirt can be avoided by depositing materials in **ultrahigh vacuum (UHV)** with the help of a **shadow mask** that is placed about 1 µm in front of the substrate.
Figure 1 shows an instrument that can move such shadow masks, as exemplarily depicted in Fig. 2a, towards a surface while **capacitively** controlling the **substrate-mask distance** down to the nm regime. Three capacitors additionally enable to keep the mask parallel to the sample surface. Depositing Pb through the holes of the mask transfers the inverse of the mask pattern to the substrate as shown in Fig. 2b.

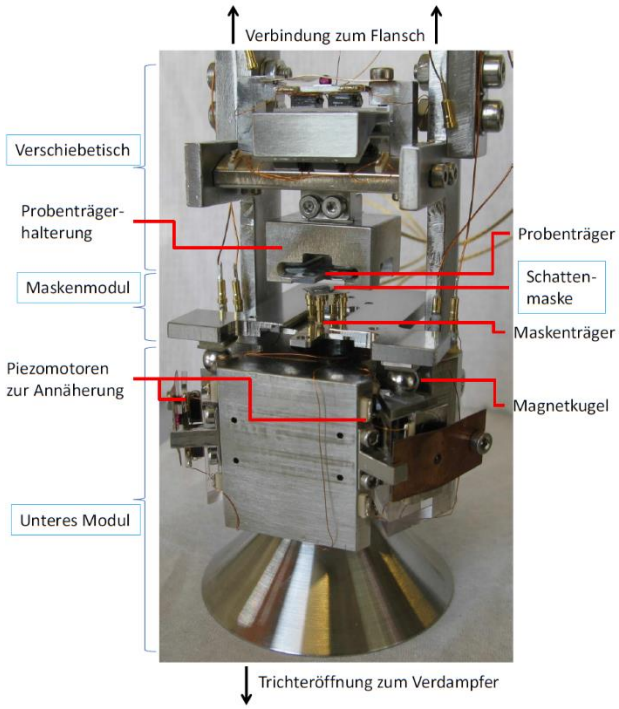

Fig. 1: Photograph of the UHV mask aligner with different parts labelled.

Within the **master thesis**, this novel process of nanostructuring should be refined by firstly using more complex masks, multiple subsequent deposition processes and other substrates. In particular, the magnetic topological insulator $MnSb_2Te_4$ should be employed that is expected to provide so-called Majorana excitations at the interface to the Pb islands which latter be investigated by scanning tunneling microscopy..

Pre-requisites: Interest in optimizing processes, basic knowledge in electronics and programming, good technical understanding, basic knowledge in solid state physics.

Begin: any time

If you are interested, please contact Jonas Beeker: jonas.beeker@.rwth-aachen.de or 0241-80-27082

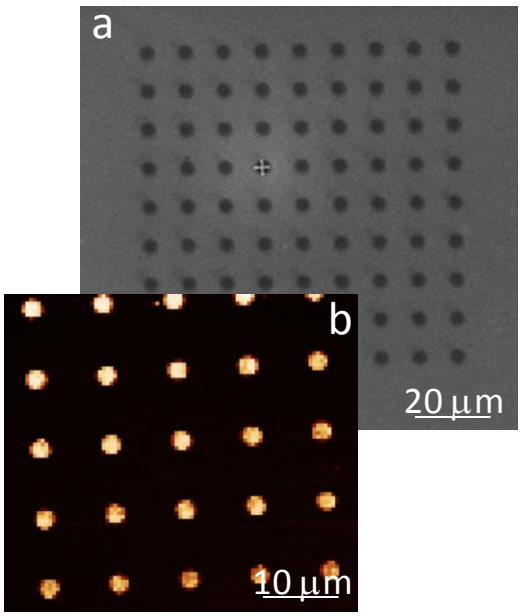

Fig.2: (a) electron microscopy image of a patterned mask with holes (b) Pb islands on Si(111) deposited in UHV through this mask, imaged by atomic force microscopy.